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PROGRESS

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Streamside Tailings Superfund Report

By the Montana Department of Health and Environmental Sciences and the U.S. Environmental Protection Agency

MDHES RELEASES REMEDIAL INVESTIGATION

The remedial investigation of the Streamside Tailings Operable Unit (SST OU) is complete. Streamside Tailings is part of the Silver Bow Creek/Butte Area Superfund site and includes Silver Bow Creek from Butte to the Warm Springs Ponds (see map, page 3). The Montana Department of Health and Environmental Sciences (MDHES) and the U.S. Environmental Protection Agency (EPA) supervised activities conducted by the Atlantic Richfield Company (ARCO), the potentially responsible party at the site. The remedial investigation determined the location, amount, and severity of metals contamination and the potential threat of these contaminants to public health and the environment. MDHES and EPA will use the results of the remedial investigation in evaluating and selecting suitable cleanup options.

This progress report summarizes the findings of the Streamside Tailings remedial investigation, and presents results of the investigation with a discussion on the extent, transport, and fate of site contaminants. The report is available for public comment at the repositories listed on page 7. The comment period ends March 13, 1995.

SITE BACKGROUND

Streamside Tailings follows Silver Bow Creek beginning just below the Colorado Tailings in Butte and extends about 25 miles downstream to the inlet of the southernmost of the three Warm Springs Ponds (see map, page 3). The Streamside Tailings area includes not only Silver Bow Creek itself, but also the adjacent mining wastes deposited along the creek banks and nearby floodplains.

Mine wastes, from milling and smelting facilities once located next to Silver Bow Creek and in Butte, have been washed down the creek for more than 100 years. These wastes, known as "tailings," are contaminated with arsenic and metals such as lead, copper, zinc, cadmium and mercury.

An estimated three million cubic yards of tailings and contaminated soils are widely scattered along Silver Bow Creek and its floodplain. For comparison, the average mid-size pickup truck holds one cubic yard of material. In some areas, the tailings are several feet thick. The largest tailings area, 160 acres, lies near the town of Ramsay and is known as Ramsay Flats.

In addition, railroad bed ballast adjacent to Silver Bow Creek was often made up of mine waste rock or slag, which are contaminated with metals. Adding to these wastes, ore concentrate, hauled by rail between Butte and Anaconda, most likely spilled along the tracts during transport. Because the railroad lines lie close to Silver Bow Creek, and contaminants in the bed and ballast can impact the creek and floodplain, they were included in the remedial investigation. People may be directly exposed to contaminants in the railroad beds as they walk along the railroad right-of-way.

Don't forget

**Roundtable meeting
Monday, February 6, 1995
7 p.m.
Fairmont Hot Springs Resort
Agenda: Cleanup alternatives: how might they affect you?**

~ Printed on ♻ recycled paper ~

THE PROBLEM

Many of the metals in the tailings are at concentrations high enough to be toxic or harmful to plants, animals and people. The tailings are typically acidic, which causes the metals to dissolve and makes them easily transported in water. Vegetation does not grow on the vast majority of tailings deposits, allowing water and wind to easily transport them. Ground and surface water have been contaminated by tailings carried as sediment in surface water or as a dissolved metal load in both ground and surface water.

In addition, during dry periods, highly soluble metal salts wick to the surface of bare tailings as soil moisture evaporates. These metal salts are quickly dissolved and washed into the creek during summer thunderstorms. Unvegetated tailings can also be readily washed into the stream by storm or snowmelt run-off. Metals transported into Silver Bow Creek have degraded the stream quality to such an extent that no fish are present and other aquatic species are extremely limited. Bare, unvegetated tailings can also be blown by winds to residential or recreational areas where they may be inhaled or ingested by people.

RESULTS OF THE REMEDIAL INVESTIGATION

Contamination was found in all media (soils, sediments, ground, and surface water) throughout most of Streamside Tailings. The site has been divided into four discrete sub-areas numbered one through four, based on well-defined physical and chemical differences (see map, page 3). More detailed information is available in the remedial investigation report and the 1991 - 1993 Data Summary Reports which can be found at the document repositories listed on page 7.

CONTAMINANT SOURCES

The investigation revealed five primary sources of contamination:

1) upstream/off-site;
2) tailings/impacted soils;
3) groundwater;
4) river sediments; and
5) railroad embankments

Upstream/off-site

Upstream sources include, but are not limited to, mine wastes in and near the City of Butte, the Butte storm water system and Butte Operations areas, and mine/mill tailings in the Colorado Tailings and Butte Reduction Works areas. Contaminants from these source areas enter Streamside Tailings primarily in Silver Bow Creek. Off-site contaminants may also enter via groundwater from the Colorado Tailings area and the Rocker Timber Framing and Treating Plant.

Tailings/impacted soils

Persistent and sometimes widespread expanses of mine wastes and mill tailings are present along nearly the entire 25-mile reach of Silver Bow Creek. Some tailings are mixed with native soils, which makes visual identification of contaminated materials difficult. The lateral and vertical extent of tailings/impacted soils was determined by analysis of 764 samples (see Table 1, page 3). The volume of these materials was estimated at 2.4 to 2.8 million cubic yards within 1,270 acres. The tailings/impacted soils range in thickness from a few inches to greater than five feet. Most of these tailings/impacted soils contain elevated concentrations of arsenic, cadmium, copper, lead, mercury, and zinc.

Contaminated groundwater

The main objectives of the groundwater investigation were to determine if groundwater was contaminated and to define the interaction between groundwater and Silver Bow Creek. Thirty on-site monitoring wells were installed and monitored. Because of the limited number of wells and their spatial distribution throughout the site's 25-mile length, groundwater characterization is discussed in terms of general site conditions and may not fully characterize the range of contaminant concentrations for the site. The 30 wells installed in the alluvium have been screened at two different depths, within 20 feet of the ground surface (upper alluvial) and greater than 20 feet below the ground surface (lower alluvial). Generally, groundwater flows toward and into the creek except in several creek reaches (the most significant being the outlet of Durant Canyon) where surface water flows into groundwater. Elevated concentrations and exceedances of drinking water standards (maximum contaminant levels [MCLs]) for metals were found in most of the shallow monitoring wells. Wells in the Rocker area are reported as part of the Rocker Operable Unit investigation.

Contaminated river sediments

A portion of the tailings and/or contaminated soil eventually resides as stream bed sediments at the bottom of Silver Bow Creek, at least for a time, before the sediments are carried downstream to Warm Springs Ponds. Bed

~ *CONT. ON PAGE 4* ~

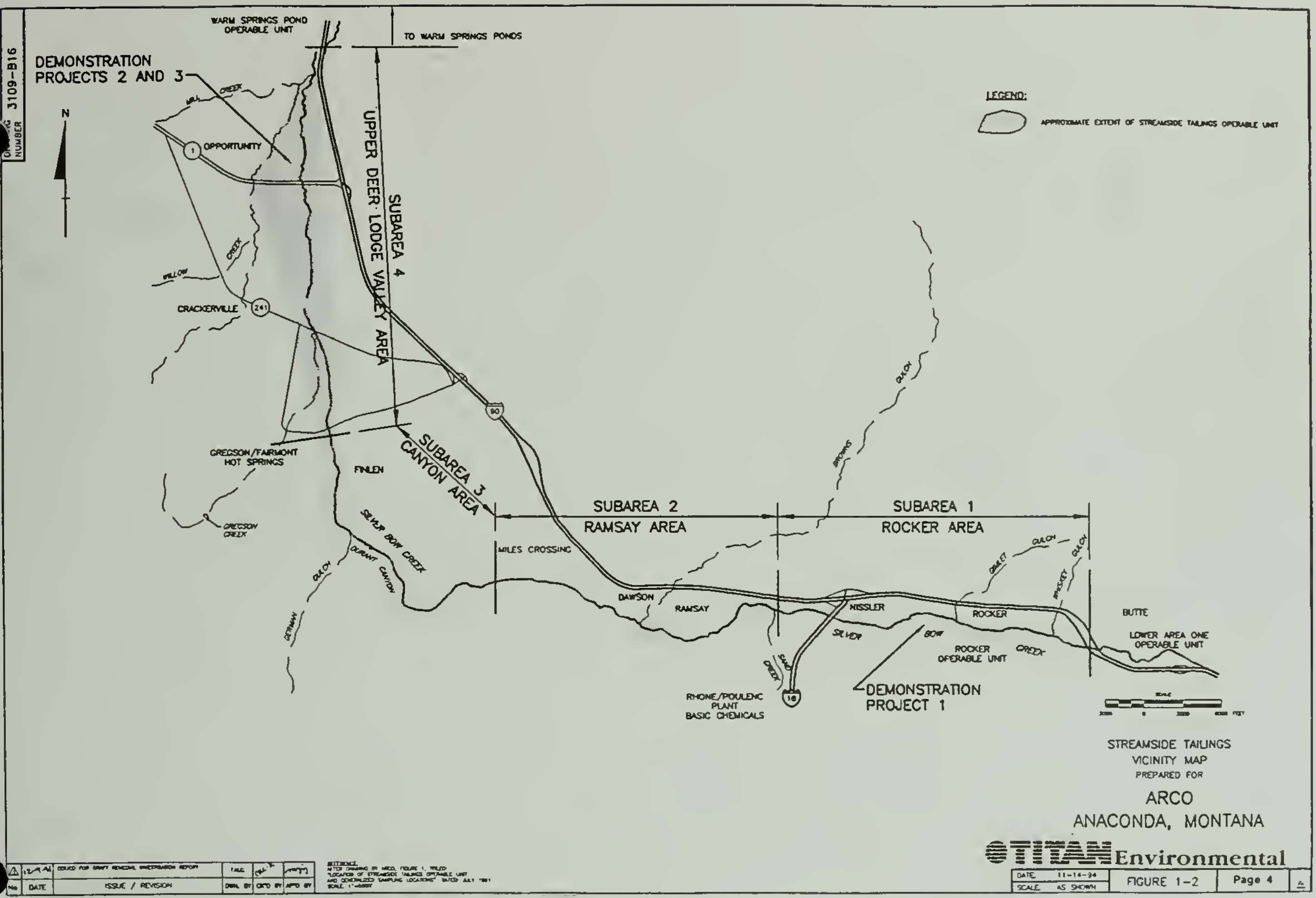


Table 1
Physical & Chemical Characteristics of the Streamside Tailings Tailings/Impacted Materials

	Natural (reference)	Subarea 1 Range	Subarea 2 Range	Subarea 3 Range	Subarea 4 Range
pH (su)	5.0 - 6.9	2.0 - 7.5	2.6 - 8.1	2.8 - 5.9	3.3 - 7.0
Arsenic (mg/kg)	6 - 142	2 - 170,000	9 - 2,640	16 - 2,544	3 - 1,690
Cadmium (mg/kg)	3 - 7	0 - 1,475	1 - 68	0 - 39	0 - 63.9
Copper (mg/kg)	20 - 295	20 - 21,300	96 - 22,300	205 - 9,040	5 - 7,190
Lead (mg/kg)	19 - 113	40 - 20,400	22 - 14,400	82 - 5,520	19 - 4,910
Mercury (mg/kg)	0.05 - 0.42	0.07 - 175	0.59 - 55.5	0.17 - 7.9	0.1 - 5.3
Zinc (mg/kg)	34 - 277	49 - 26,800	188 - 25,700	441 - 7,910	58 - 7,670
Tailings Volume (cy)	NA	246,000	850,000	160,000	1,143,000
Tailings Area (acres)	NA	156	320	92	702

Range = Highest and lowest values measured, NA = Not Applicable, Total Tailings Area = 1,270 acres, Total Tailings Volume = 2.4 - 2.8 million cubic yards

~ CONTINUED FROM PAGE 2 ~

sediments are contaminated with metals. While in the stream, these sediments most likely serve as a source of metals to the surface water system or may impact aquatic life in the stream bottom.

Railroad embankments

Certain portions of several historic and existing railroad embankments along Silver Bow Creek were constructed with mine waste rock and/or mine and mill tailings. This material represents a potential minor source of metals to groundwater or to Silver Bow Creek via runoff.

CONTAMINANT MOVEMENT

Figure 2 on page 5 shows the current generalized conceptual model of contaminant movement within the Streamside Tailings. Contaminants move through the area and between environmental media in response to a variety of processes. Some of the primary means by which contaminants may move within the Streamside Tailings include:

Erosion/runoff

Erosion/runoff is one of the most obvious contaminant transport mechanisms. Erosion, as it is discussed here, encompasses three major processes: mass wasting, bank erosion and slumping. Precipitation or snowmelt runoff moves metals-bearing materials through erosion and carries the contaminants to Silver Bow Creek. Metallic salts are sometimes wicked to the surface of tailings through capillary action and are subsequently eroded by water into the stream. Elevation change in Silver Bow Creek itself can cause undercutting of banks and direct erosion of metals-laden streambank materials. In addition, ice buildup in the stream during winter months can cause streambank erosion. People and animals can cause streamside tailings to directly enter the creek by disturbing the tailings/impacted soils on the bank.

Surface water flow

Water entering (inflow) the Streamside Tailings from upstream areas is highly contaminated (see Table 2, this page). In addition, the water quality data indicate that contaminants are added to Silver Bow Creek in the upper portion of the Streamside Tailings during most flow conditions. This general trend is best typified by "low-flow" water quality data for copper and zinc (see Table 2, this page). The average low-flow total copper concentration increases from 178 micrograms per liter (ug/l) at upstream station SS-07 to 322 ug/l at station SS-10 located at the downstream end of Subarea 1. Likewise, average total zinc concentrations during low-flow conditions increased from 682 ug/l to 860 ug/l between these two stations. Loading data for copper and zinc indicate trends similar to the concentration data. Below the mouth of Durant Canyon, concentrations and loading generally decrease as Silver Bow Creek flows to the Warm Springs Ponds during low flow. Aquatic systems are extremely sensitive to elevated levels of copper and zinc.

Tailings and groundwater interactions

In many areas, groundwater is in direct contact with tailings for at least part of a typical year. Groundwater level fluctuation is estimated at one to two feet. This direct contact mobilizes metals quickly from the tailings, which in turn contaminate the groundwater. This is a principal mechanism for groundwater contamination at the site.

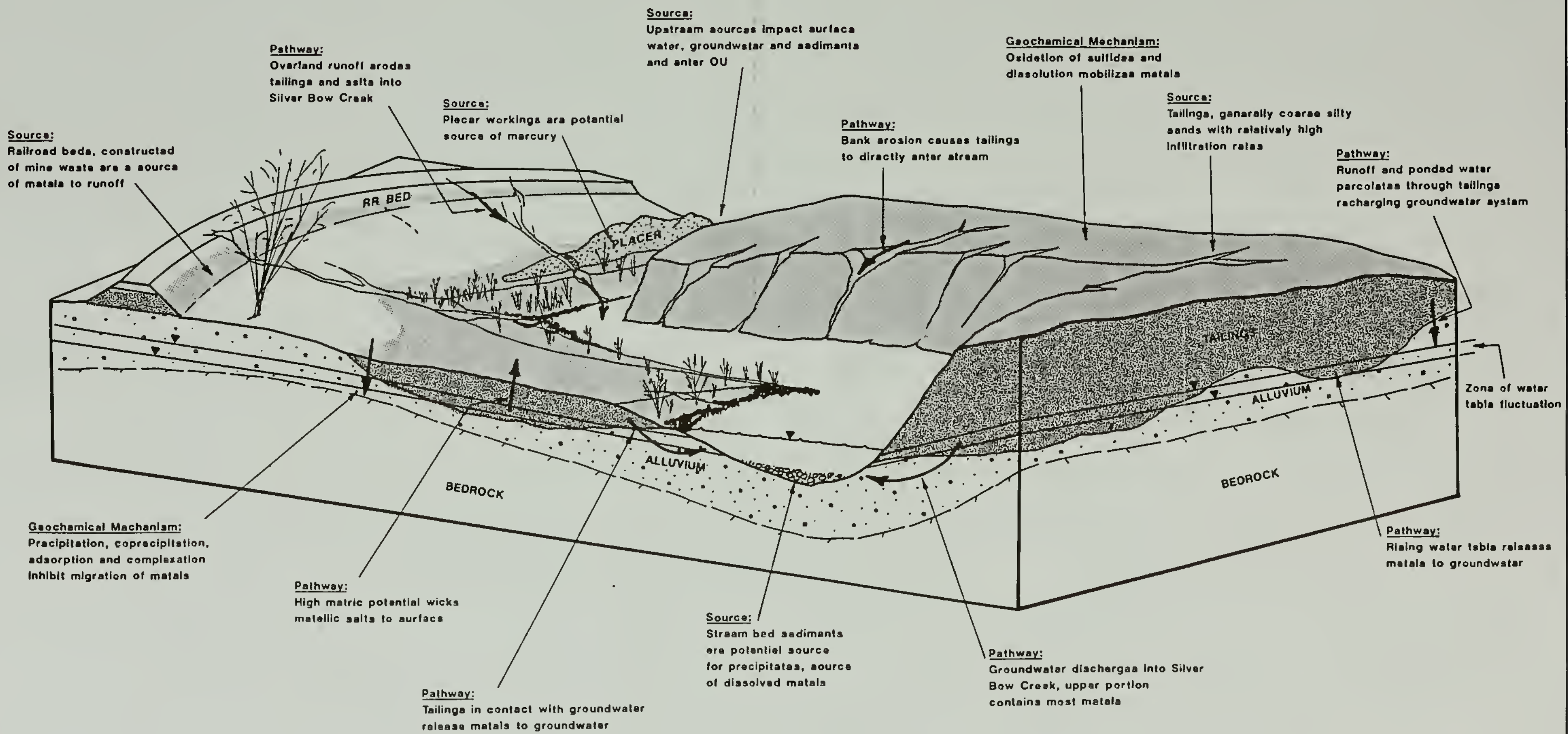
Movement of water from the tailings on the surface

Table 2
Silver Bow Creek Water Quality - Average Low Flow Conditions

	Gold Book		SS - 07 (inflow)	SS - 10 (Silver Bow)	SS - 14 (Miles Crossing)	SS - 16 (Fairmont)	SS - 17 (Opportunity)
	Chronic	Acute					
pH (su)	NA	NA	7.3	8.0	7.9	8.2	9.6
Arsenic (µg/l)	190	360	8.7	14.5	11.7	15.4	18
Cadmium (µg/l)	1.1	3.9	1.6	2.5	1.1	1.1	0.7
Copper (µg/l)	12	18	178	322	163	140	140
Lead (µg/l)	3.2	82	5.3	15.2	5.4	4.6	1.9
Zinc (µg/l)	110	120	682	860	532	455	366

Note: All values given in "total" concentrations.

Figure 2


Source:
Railroad beds, constructed of mine waste are a source of metals to runoff
Pathway:
Overland runoff erodes tailings and salts into Silver Bow Creek
Source:
Placer workings are potential source of mercury
Source:
Upstream sources impact surface water, groundwater and sediments and enter OU
Pathway:
Bank erosion causes tailings to directly enter stream
Geochemical Mechanism:
Oxidation of sulfides and dissolution mobilizes metals
Source:
Tailings, generally coarse silty sands with relatively high infiltration rates
Pathway:
Runoff and ponded water percolates through tailings recharging groundwater system
RR BED
PLACER
TAILINGS
ALLUVIUM
ALLUVIUM
BEDROCK
BEDROCK
Zone of water table fluctuation
Geochemical Mechanism:
Precipitation, coprecipitation, adsorption and complexation inhibit migration of metals
Pathway:
High matric potential wicks metallic salts to surface
Pathway:
Tailings in contact with groundwater release metals to groundwater
Source:
Stream bed sediments are potential source for precipitates, source of dissolved metals
Pathway:
Groundwater discharges into Silver Bow Creek, upper portion contains most metals
Pathway:
Rising water table releases metals to groundwater

CONCEPTUAL MODEL
OF SUBAREA 1

December 1994 | FIGURE 4-22 | Page 194

through the unsaturated (vadose) zone in a tailings deposit and into the saturated (groundwater) zone is another method by which contaminants move in the environment within the study area. This is most likely to happen during longer precipitation or snowmelt events. Metals weakly held to tailings are leached by the infiltrating water and eventually can be carried into the underlying native soils and groundwater. Profiles of many soils in the Streamside Tailings show evidence of metals migration from the tailings into underlying native materials. Table 3, on page 6, presents the volumes of tailings which are saturated with groundwater throughout the year and for a portion of the year.

Ground and surface water interactions

Contaminated groundwater flows into Silver Bow Creek along many reaches of the stream. This is most likely to happen in areas where the creek gains flow from the groundwater and results in the greatest impact to the quality of Silver Bow Creek during low-flow conditions (see Table 2, page 4). Because most surface water contaminant concentrations increase in Subareas 1 and 2 of Silver Bow Creek during low flow conditions, it is probable that the quality of the stream is impacted to a degree by sources within these reaches. Since many of the possible pathways for contaminant movement are inactive during low-flow conditions (e.g., runoff, infiltration, evapotranspiration), it is probable that the primary pathway that would explain the trends in metals concentrations and loadings is inflow of metals-bearing groundwater.

By the same token, surface water may flow into, and contaminate, groundwater. Such a mechanism of metals movement would be most probable when the stream level is high.

CONTAMINANT FATE

Silver Bow Creek surface water and bed sediments are the primary recipient of contaminants from the Streamside Tailings as well as from off-site sources. Contaminants predominately enter the stream through runoff during precipitation/snowmelt events and from groundwater inflow. As previously stated, the quality of Silver Bow Creek is degraded by releases from sources upstream from Streamside Tailings.

Metal compounds are typically most soluble at low (acidic) pH. Generally, acidic groundwater transports contaminants to the relatively higher pH water of Silver Bow Creek. When acidic, contaminated groundwater discharges into the higher pH creek, contaminants may precipitate out of the water and adsorb onto bed sediments. Therefore, contaminated groundwater is a likely source of additional contamination to bed sediments.

Silver Bow Creek discharges into the Warm Springs Ponds at the lower end of Silver Bow Creek. Contaminants are transported by Silver Bow Creek in varying forms and are, for the most part, removed from the water through the treatment system operated at the Warm Springs Ponds. Therefore nearly all metals which move through Silver Bow Creek will, ultimately, either be deposited in the Warm Springs Ponds or carried into the upper Clark Fork River. The time required for the contaminants of concern to achieve this fate depends on the magnitude of various mechanisms affecting movement.

Because the Warm Spring Ponds are sized to treat Silver Bow Creek water at flows up to the 100-year flood flows, flows greater than this will bypass the ponds directly into the Clark Fork River. Untreated contaminants could make their way into the Clark Fork River during these higher flows.

Contaminants not carried into Silver Bow Creek may also be attached to the soil. These metals will remain in this stable form until geochemical conditions alter the chemical stability of the soil system to re-release the metals.

Table 3
Estimated Volume of Saturated Tailings

Subarea	Total Volume of Tailings (cy)	Volume Saturated at ALL TIMES (cy)	Volume Saturated During PART OF YEAR (cy)
1	243,000	49,000	162,000
2	850,000	8,000	60,000
3	160,000	5,000	53,000
4	1,143,000	32,000	209,000
Total	2,396,000	94,000	484,000

Note: All volumes are in cubic yards (cy); For subarea location, see Figure 1

GET INVOLVED

The Superfund staff encourage you to get involved with the decision-making process for Streamside Tailings. There are a number of ways to be involved:

1. Site mailing list:

To receive progress reports such as this one, as well as notices of public meetings, fill out and mail the address form provided on page 8.

2. Roundtable:

MDHES sponsors Citizens Roundtable meetings. If you are interested in discussing Streamside Tailings cleanup, this is a forum we encourage you to consider. The next Roundtable meeting is Monday, February 6, 1995, at Fairmont Hot Springs Resort. Everyone is encouraged to attend.

3. Call MDHES:

MDHES Streamside Tailings Project Officer Jim Ford and Superfund Public Information Officer Jane Heath are available to discuss the project with the public, either individually or at group meetings. You can reach Jim or Jane by calling the MDHES Superfund toll-free number in Helena: 1-800-246-8198, from 8 a.m. to 5 p.m., weekdays, except holidays.

Or you may wish to talk with the U.S. Environmental Protection Agency staff in Helena who provide management assistance to MDHES. At EPA, contact Mike Bishop, Remedial Project Manager or Pam Hillery, Community Involvement Specialist at (406)449-5720.

4. Comment on the remedial investigation:

MDHES would like to know your comments about the remedial investigation. The 60-day comment period closes Monday, March 13, 1995. Please address your comments to: Jim Ford, MDHES, P.O. Box 200901, Helena, MT 59620-0901.

5. Read the documents:

Documents concerning the site are available for public review at a variety of locations throughout the Clark Fork Basin. Repositories can be found at the following locations:

Butte:

1. Silver Bow Library
2. Montana Tech Library
3. EPA office in the basement of the Courthouse
4. CTEC office at Montana Tech

Anaconda:

1. Hearst Free Library

Deer Lodge:

1. National Park Service Office
2. Deer Lodge Public Library

Missoula:

1. Missoula Public Library
2. University of Montana Mansfield Library
3. Clark Fork - Pend Oreille Coalition Office

Helena:

1. MDHES office at 2209 Phoenix Ave.
2. EPA office in the federal building
3. State Library
4. Montana Historical Society Library

Bozeman:

1. Montana State University Renne Library

MDHES SUPERFUND HOTLINE:
USE IT!
1-800-246-8198

ARE YOU ON OUR MAILING LIST?

If you wish to receive periodic information about Streamside Tailings, or if you wish to update your address, please fill out, detach, and mail the following form to Jane Heath, Montana Department of Health and Environmental Sciences, P.O. Box 200901, Helena, MT 59620-0901.

Name ____________________

Address ____________________

City, State ____________________

Zip ____________________

I want to receive (check one) :
- Just progress reports and meeting notices like this one ______
- Just Roundtable announcements and newsletters ______
- All Streamside Tailings mailings ______

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